



# Head Roll Stabilization and Muscle Mitigation Mechanism in Human Distance Running

## Citation

Whitcome, Katherine K., Daniel E. Lieberman, Dennis M. Bramble, David A. Raichlen, C. Sloan. 2008. Head roll stabilization and muscle mitigation mechanism in human distance running. Abstracts of AAPA poster and podium presentations. American Journal of Physical Anthropology 135(S46): 222.

## Published Version

<http://dx.doi.org/10.1002/ajpa.20806>

## Permanent link

<http://nrs.harvard.edu/urn-3:HUL.InstRepos:2894772>

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Head roll stabilization and muscle mitigation mechanism in human distance running  
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**Abstract:**

Humans experience relatively high ground impact forces during running that can destabilize the head, especially at heel strike. Although head pitch is by far the largest challenge, an appreciable degree of roll also occurs (as is evident when a runner's pony-tailed hair swings recurrently from side to side). Here we analyze the kinematic and kinetic forces of head roll and how the body stabilizes angular accelerations in the coronal plane. At endurance running speeds, the head rolls towards the stance side approaching  $50\text{s}^{-1}$ , reaching peak rates near midstance, well after the time of peak pitching rates. Our analysis identifies a roll mediating mechanism in activation of the swing side sternocleidomastoid muscle (SCM) just before heel strike followed by a peak magnitude burst of the muscle some 40-80ms before the head attains peak roll rate. The SCM fires on the stance side as well but with much shorter duration and lower magnitude, suggesting that the increased activity of the swing side SCM functions in head roll control. There is no apparent correspondence of unilateral activity of the cranial and cervical trapezius muscles with head roll.